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RAMAN MODE SOFTENING ACROSS THE SUPERCONDUCTING TRANSITION OF A MAGNESIUM DIBORIDE SUPERCONDUCTOR

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The recently discovered magnesium diboride (MgB_2) polycrystalline superconductor has again stimulated the interest in conventional BCS superconductors that, as opposed to most high-temperature superconductors, can possess the high levels of critical current density so essential for magnetic field applications of superconducting materials. However, much remains to be learned about the structural mechanisms behind the magnesium diboride superconducting system. One of the most useful tools for an analysis of the structural features most involved in phonon-mediated superconductivity is the technique of Raman spectroscopy. In this study, we have collected the Raman spectra of a magnesium diboride polycrystalline superconductor over a large range (150 - 800 cm^{-1}) of wavenumber shifts at temperatures ranging from 18K - 300K. We have observed almost no change in the major Raman-active phonon mode at 474 cm^{-1} with the decrease of sample temperature in the normal state. Immediately above and below the critical temperature (measured as around 38 K onset for our sample) we collected the spectra at a finer grid of temperatures in order to more accurately observe the specific phonon mode softening as the sample passed through the superconducting transition. For the major Raman-active mode, the softening through the superconducting transition was around 2 cm^{-1}, with this mode gradually hardening once the sample is fully superconducting. A similar mode softening was observed in the Raman-active mode at 616 cm^{-1} as the superconducting transition took place, with little or no change occurring in two other modes. The Raman spectra were collected over multiple averaged scans with a GaAs PMT and a Triax 550 spectrometer equipped with a holographic Super-Notch Plus filter and were excited with 150 mW of 4880Å argon ion laser radiation at the sample surface. These spectra have provided us with further insight into the specific phonons responsible for the mediation of the Cooper pairing of the electrons on which BCS superconductors are inherently dependent.